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Comparison of Ionic and Manual Toothbrush in Reduction in Plaque and Gingivitis

Medical Science

KEYWORDS : Gingival bleeding, gingivitis, plaque, ionic toothbrushes, toothbrushing

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ABSTRACT

Background:

A paucity of conclusive research exists on the optimal design and mode of action of toothbrushes, leading to the introduction of new generation of toothbrushes. Ionic toothbrushes belong to this new generation of toothbrushes. The aim of the present study was to clinically assess and compare the efficacy of the ionic and manual toothbrushes.

Materials and Methods:

A single blind study, using a split-mouth method, was conducted for 45 days on a total of 22 (11 males and 11 females) student volunteers, with age of 17 to 21 years. Plaque, gingival, and bleeding indices were recorded after every 15 days.

Results:

Both the toothbrushes showed significant reduction in all three parameters. However, the ionic toothbrush proved to be more effective than the manual toothbrush on the percentage basis, the difference in parameters was statistically nonsignificant.

Conclusion:

It may be concluded from the present study that though the ionic toothbrush was insignificantly superior to the manual toothbrush, both the tooth brushes are clinically effective in removing plaque and improving the gingival conditions.

INTRODUCTION:

It has long been recognized that the presence of dental plaque leads to gingivitis and periodontal disease, as well as dental caries. Today tooth brushing is the most widely accepted method of removing plaque (1,2). Hence this present clinical study was undertaken to evaluate the effectiveness of an ionic toothbrush on oral hygiene status. For this study, 20 people in the age group of 18-50 years were included. Half of the subjects after undergoing dental prophylaxis were then provided with ionic toothbrushes, and another half were asked to brush with regular toothbrush. Plaque index and gingival bleeding index were examined at 7th, 14th, and 21st day. Results shown a significant reduction in all the parameters and the reduction was more significant in both toothbrush users. It was concluded that both toothbrushes reduced the plaque index and gingival bleeding index scores significantly and ionic tooth brushes were more effective as compared to normal toothbrushes. There was no soft tissue trauma following the use of both types of toothbrushes, which showed that ionic toothbrushes were equally safe for regular long-term use

The toothbrush is the most widely used plaque control instrument in populations. Its mechanism of action is related to the mechanical attrition that occurs between the bristles and the dental surface, disrupting the biofilm (3, 4).

Periodontal disease and dental caries, both plaque related diseases are recognized as two of the most common diseases worldwide and it has long been recognized that the presence of dental plaque leads to gingivitis and periodontal disease, as well as caries(1). Today tooth brushing is the most widely accepted method of removing plaque and has a very high degree of social acceptability (4). Tooth brushes now come in bewildering range of styles and varieties accomplished by complex product descriptions and scientific design theories, but no research team has yet come up with conclusive proof that one brand performs better than other(5).

Ionic toothbrush works on the principle of polarity that every element in nature has a positive or negative charge (6). So far only few studies have been undertaken to assess efficiency of ionic toothbrush and have revealed inconsistent results (7). Hence this present clinical study is undertaken to evaluate the effectiveness of ionic toothbrush on oral hygiene status including clinical parameters such as plaque index and bleeding index. Additionally, microbial colony count was assessed from plaque taken before brushing and after brushing for groups using active ionic toothbrush.

PRINCIPLES OF THE IONIC ACTION MECHANISM:

The bonding between the pellicles and bacteria is mediated by Ca^{2+} bridge formation. The anions supplied by the lithium battery inhibit the bonding between the bacteria and Ca^{2+} and prevents the bacteria from adsorbing to the pellicles. Hence the plaque accumulation is reduced because the above mentioned anions continuously supplied from the tips of the bristles of the ionic toothbrushes prevent the mild electrostatic bonding between the bacteria per se.

MATERIALS AND METHODS:

Screening and selection of subjects

A total of 22 individuals (11 males and 11 females), with age of 17 to 21 years (mean age – 18.8+1.02), were screened, selected, and stratified, according to inclusion and exclusion criteria by examiner Dr. Nalini Jain.

Inclusion criteria consisted of subjects:

with good general health,

without any systematic diseases,

with disease known to affect oral tissues,

who had not received any periodontal therapy for past 3 months,

who had not taken any antibiotics or antiseptic mouthwashes since last one month prior to study,

with full complement of teeth, except third molars,

With ability to attend hospital at recall intervals.

Exclusion criteria consisted of subjects:

with orthodontic appliances,

using any other supplemental plaque control methods,

with five or more carious teeth requiring immediate treatment,

with mucogingival problems like high frenal attachment,

with manual dexterity conditions,

Who were taking drugs that could affect state of gingival tissues including corticosteroids and nonsteroidal anti-inflammatory drugs

Material used Ionic toothbrush (hyG, Hukuba Dental, Nagareyama, Japan) and sensodyne expert toothbrush. [Figures1, 2 and 3].

Study design
A single blind study, using a split mouth method, i.e., using ionic on one side's upper and lower arch and sensodyne expert on other side's upper and lower arch, was designed. The study was designed for 45 days and indices were recorded after every 15 days (0, 15, 30, and 45 days).

Consent for participating in the study was taken from all volunteers. Baseline scoring of plaque index (PI)(8) using a two-tone disclosing agent (Alpha Plac), modified gingival index (MGI),(9) and gingival bleeding index (GBI)(10) was done. The volunteers had not yet started brushing with the given brushes.

Instructions were given to use only the given brushes on assigned sides twice daily for 3 minutes by the assigned tooth brushing technique, with assigned dentifrice (sensodyne fresh gel) only. Volunteers were asked to refrain from brushing 24 hours before every recall visit and return for periodic examination after every 15 days, that is, on 15th, 30th, and 45th days till the end of study. During each recall visit, plaque, gingival, and bleeding indices were scored. Only Dr. Nalini Jain knew on which side each of the brush was used, and was not involved in clinical scoring of indices. Compliance and comments about brushes were determined by a questionnaire at each recall visit. Also, instructions, including the brushing technique, were reinstated at each recall visit.

Statistical analysis
Intragroup comparisons were analyzed by paired t test and intergroup comparisons of reductions in various clinical parameters between two groups were analyzed by Mann-Whitney test. *P* value of <0.05 was considered statistically significant.

RESULTS
Modified gingival index
Mean reduction in MGI scores for both the brushes has been shown in Table 1. Though the sensodyne toothbrush was better in result on 15th day and at the end of study, the ionic toothbrush showed more reduction on 30th day. On intergroup comparison, the difference in *P* values (*P* value - 0.37, *P* value - 0.37, *P* value - 0.53, *P* value - 0.92, and *P* value - 0.18, respectively) was found to be statistically nonsignificant for 0-15th, 0-30th, 0-45th, 15th-30th, 30th-45th day intervals.

Plaque index
As shown in Table 2 the ionic toothbrush showed more reduction on 15th and 30th day, while both the toothbrushes showed almost same reduction on 45th day. *P* value - 0.78, 0.27, and 0.94 for the respective time intervals was again found to be statistically nonsignificant. Also, *P* value - 0.82 and *P* value - 0.69, respectively for 15th–30th day and 30th–45th day intervals, was found to be statistically nonsignificant.

Gingival bleeding index
As shown in Table 3, reduction in GBI was more in case of sensodyne toothbrushes at the end of the study (45th day), while, the ionic toothbrushes showed more reduction on 15th and 30th day. The difference in *P* values (*P* value - 0.72, *P* value - 0.67, and *P* value - 1.00, for 15th, 30th, 45th days respectively) was found to be statistically nonsignificant. Also, for the time intervals 15-30 days and 30-45 days, the difference in *P* values (*P* value - 0.15 and *P* value - 0.61, respectively) was found to be statistically nonsignificant.

DISCUSSION:
Use of devices with ionic action in the oral cavity is not a new concept. The terms iontophoresis, electrophoresis, and electrolyzing have been used in dentistry for many years. Ionic toothbrush is only slightly larger than the manual toothbrush, with replaceable brush-heads, and works on the principle of changing surface charge of tooth to repel plaque even from inaccessible areas of teeth. It is also speculated that the activated anions might inhibit coupling between the pellicle and bacteria, mediated by calcium bridges. The important ionic exchange, along with the normal mechanical action of the bristles on the tooth surface, enhances plaque removal(figure 4).

The study was designed to be a single blind study, thus reducing the bias error. Split-mouth study was designed to reduce interpatient difference and made sure that similar conditions apply for both the brushes. Heasman and Mc Craken(11) considered split-mouth study of greatest value for evaluation of plaque-removing efficacy, especially for powered toothbrushes.

One problem in the design of short-term brushing studies is that the amount of plaque to be removed may decrease in the course of study due to motivation and brushing experiences.(12,13) To avoid such problems, we chose to use a standardized period of at least 24 hours of plaque accumulation before each recall visit. This might have also reduced the "How thorne effect?" that is, the patients brush more consciously on the day of recall. (14)

In a short-term clinical study, many different factors such as duration of tooth brushing, manual dexterity, motivation, frequency of tooth brushing, technique and thoroughness of tooth brushing, type of dentifrice being used, regularity and punctuality of follow-up appointments, and "novelty-effects"(15) may interfere with results. On the other hand, lack of interest on the part of participants and increased number of drop-outs in case of long-term studies can lead to frustration of examiners and an overall effect on the results. (11)

Subjects using any additional plaque control measures like interdental cleansing aids and mouthwashes were not selected because it could have affected the outcome of this study. Third molars were not included because of the difficulty in visibility and accessibility. Subjects wearing orthodontically bound appliances, removable or fixed prosthesis, or having grossly destructed teeth were also not included because of asymmetrical pattern of plaque formation in these patients and also these iatrogenic factors may annoy their users by greater propensity to fray.

Brushing twice daily at 10- to 12-hour interval has been advised, since early plaque is more vulnerable to mechanical action.(16) The duration of tooth brushing has an al-

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most linear monotonic effect on plaque reduction, which may vary between 30 seconds to 8 minutes.(17) As a result, the possible differences between toothbrushes may be obscured. Hence, we decided to standardize the minimum brushing time for optimum plaque removal, that is, 3 minutes twice daily as suggested by Pader. (18)

Our results confirm findings of other previous studies by Maki *et al*. (20) and Van Swol *et al*. (21) that reported a significant reduction in gingival index using ionic toothbrush. Electrically charging tissue, in addition to mechanical plaque removal by ionic toothbrush, might show additional improvements in gingivitis.(22) Toshihoro *et al*.(23) stated that anions might be activated that inhibit coupling between pellicle and bacteria, mediated by calcium bridges. This may result in its effectiveness in removing plaque. Plaque-removing effect of ionic toothbrush has also been reported by various other authors.(19,20,24,25) Ionic toothbrush was found to have no beneficial effect on gingiva and plaque in at least one study, probably, because of the bulky design of the brushes used in that study, which were designed to have vibratory action in addition to current transfer. This vibratory action was switched off during their study, indicating some difficulty in manipulation. (26)

There was no ulceration or gingival ablation noticed by use of either of the brushes. A slight increase/less reduction in parameters were seen between 30th and 45th day for both brushes. This may be attributed to gradual reduction of initial novelty effect (24) and/or Hawthorne effect. (14)

Ionic toothbrush was more like any other manual toothbrush. Though ionic toothbrush also has a new mode of action, it does not make much difference to the subject while brushing.

CONCLUSION

During this 45-day clinical trial, no adverse effects were found or reported for both brushes. Based on the data, this study demonstrates that both toothbrushes are capable of removing plaque and reducing gingivitis and bleeding effectively. The results show that the ionic toothbrush showed better results as compared with the sensodyne toothbrush, though the difference was statistically insignificant.

TABLE 1: Modified Gingival Index
Comparison of reduction in gingival index at different time intervals

Time interval (days)	Ionic Mean reduction ± SD	% Reduction	SENSODYNE Mean reduction ± SD	% Reduction	DIFFERENCE P value	significance
0-15	0.32± 0.54	25.2	0,21± 0.56	18.1	0.37	NS
0-30	0.55± 0.46	43.3	0.43± 0.53	37.1	0.50	NS
0-45	0.63± 0.59	49.6	0.52± 0.63	44.8	0.53	NS
15-30	0.23± 0.24	24.2	0.21± 0.25	22.1	0.92	NS
30-45	0.08± 0.25	11.1	0.09± 0.18	12.1	0.18	NS

TABLE 2: Plaque Index
Comparison of reduction in plaque index at different time intervals

Time interval (days)	Ionic Mean reduction ± SD	% Reduction	SENSODYNE Mean reduction ± SD	% Reduction	DIFFERENCE P value	significance
0-15	0.48± 0.67	27.1	0.53± 0.58	30.3	0.78	NS
0-30	0.75± 0.59	42.4	0.81± 0.62	46.3	0.27	NS
0-45	0.75± 0.70	44.6	0.77± 0.70	44.0	0.94	NS
15-30	0.27± 0.53	20.9	0.29± 0.53	22.9	0.82	NS
30-45	0.04± 0.64	3.9	0.04± 0.55	4.3	0.69	NS

TABLE 3: Gingival Bleeding Index
Comparison of reduction in bleeding index at different time intervals:

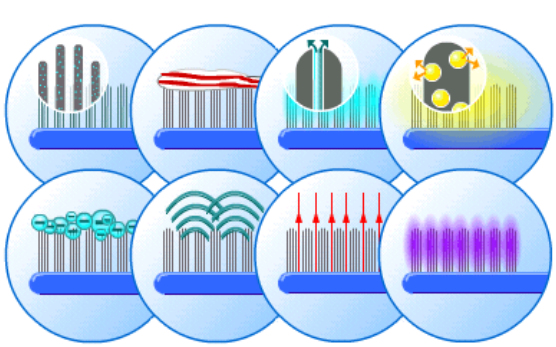
Time interval (days)	Ionic Mean reduction ± SD	% Reduction	SENSODYNE Mean reduction SD	% Reduction	DIFFERENCE P value	significance
0-15	3.9± 13.1	10.9	5.4± 12.5	15.2	0.72	NS
0-30	14.9± 13.0	41.6	13.4± 8.2	37.7	0.67	NS
0-45	20.2± 12.8	56.4	17.9± 10.4	50.4	1.00	NS
15-30	11.0± 7.9	34.5	8.0 ± 11.3	26.6	0.15	NS
30-45	5.3 9±.3	25.4	4.5 ± 6.5	20.4	0.61	NS

Figure 1:

Figure 2:

Figure 3:

Figure 4:



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